# Women, Children, and Industrialization in the Early Republic: Evidence from the Manufacturing Censuses

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# *Women, Children, and Industrialization in the Early Republic: Evidence from the Manufacturing Censuses*

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Manufacturing firm data for 1820 to 1850 are employed to investigate the role of women and children in the industrialization of the American Northeast. The principal findings include: (1) Women and children composed a major share of the entire manufacturing labor force; (2) their employment was closely associated with production processes used by large establishments, both mechanized and non-mechanized; (3) the wage of females (and boys) increased relative to that of men with industrial development; and (4) female labor force participation in industrial counties was substantial. These findings bear on the nature of technical change during early industrialization and why American industrial development was initially concentrated in the Northeast.

*The first objection [the dearness of labor] ceases to be formidable when it is recollected how prodigiously the proportion of manual labor in a variety of manufactures has been decreased by the late improvements in the construction and application of machines—and when it is also considered to what extent women and children in the populous parts of the country may be rendered auxiliary to undertakings of this nature.*

—attributed to Alexander Hamilton (1791)

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I

DURING the first half of the nineteenth century, the manufacturing sector in the northeastern region of the United States expanded very rapidly and was characterized by the introduction of a series of innovations such as the factory system of production. Many scholars have argued that this initial phase of industrialization in America was marked by a search for ways to reduce the cost of labor. In this view, an abundance of agricultural land contributed to the development of labor-saving and capital-intensive technologies, by serving to establish a high price for male labor. It has been less widely acknowledged that American industry also responded to the high relative price of adult males by adapting its organization of work to utilize alternative sources of labor provided by women (generally young and unmarried) and children.[1] Previous studies of women and children in manufacturing have focused on their employment in the highly mechanized textile industries, but these groups also constituted substantial proportions of the labor forces of many other industries that did not experience significant mechanization prior to 1850.[2] The demands of these other industries for female and child workers were enhanced by less dramatic innovations that involved a more intricate division of labor within the firm, a more disciplined work regime, and a larger scale of operation.[3]

[1] The notion that abundant land provided an incentive for labor-saving technical change can be traced back to many early nineteenth century observers. The best known recent exposition of this argument is H. J. Habakkuk, *American and British Technology in the Nineteenth Century: The Search for Labour Saving Inventions* (London, 1967); however, see Richard Clarke and Lawrence Summers, "The Labour Scarcity Controversy Reconsidered," *Economic Journal,* 90 (March 1980), 129–39, for a more formal modeling of the role of land availability in the process of industrialization. While the major emphasis has been on the use of capital to conserve on labor, Habakkuk recognized that females and children were also used (p. 65). Stanley Lebergott, *Manpower in Economic Growth: The American Record Since 1800* (New York, 1964) contains an insightful discussion of the substitution of female and child for adult male labor and the workings of this early market in unskilled labor (pp. 125–29). The literature on the substitution of females and children for male labor in the British experience is extensive. See, for example, Ivy Pinchbeck, *Women Workers in the Industrial Revolution* (London, 1930), and Peter Mathias, *The First Industrial Nation: An Economic History of Britain, 1700–1914* (London, 1969), Chapters 1 and 5.

[2] See Thomas Dublin, *Women at Work: The Transformation of Work and Community in Lowell Massachusetts, 1826–1860* (New York, 1979) and Pamela J. Nickless, "Changing Labor Productivity and the Utilization of Native Women Workers in the American Cotton Textile Industry: 1825–1860," unpublished Ph.D. dissertation, Purdue University, 1976, among other recent additions to this literature. Edith Abbott, *Women in Industry: A Study in American Economic History* (New York, 1910) has coverage of most of the important industries, but with little systematic analysis of the pre-1850 period. The employment of women in the paper industry is discussed in Judith A. McGaw, " 'A Good Place to Work.' Industrial Workers and Occupational Choice: The Case of Berkshire Women," *Journal of Interdisciplinary History,* 10 (Autumn 1979), 227–48. The cotton textile industry has also dominated the literature on the substitution of child and female labor in Britain, e.g., Clark Nardinelli, "Child Labor and the Factory Acts," this JOURNAL, 40 (Dec. 1980), 739–55.

[3] This conception of early industrialization seems consistent with that of Thomas Cochran, *Frontiers of Change: Early Industrialism in America* (New York, 1981) who writes: "An

The extent to which the manufacturing sector drew on women and children in recruiting workers during the initial period of industrialization has seldom been fully appreciated. In this paper we seek to document it. In doing so, we have two purposes in mind. The first is to present a systematic description and analysis of the developments that led to the emergence of substantial female participation in the American market economy. The second is to direct attention to an important stream of technological change that was characteristic of many manufacturing industries during the crucial early stages of industrial development. Our central theme is that the rapid growth of the manufacturing sector was associated with a disproportionate increase in the demand for women and children as workers, because the spread of new large-scale methods of production greatly facilitated the substitution of unskilled for skilled labor. The increase in the demand for these classes of workers was further augmented by the expanding manufacturing sector being intensive in women and children relative to agriculture. In the sections below, we shall show that these factors accounted for a substantial increase in the employment of women and children across much of the northeastern manufacturing sector. The proportion of the northeastern manufacturing labor force composed of females and young males seems likely to have grown from about 10 percent early in the nineteenth century to roughly 40 percent by 1832; and although it began to decline soon afterward, it remained above 30 percent in 1850. The radical shift in the composition of the industrial labor force was accompanied by nearly a doubling of the wage of females relative to that of adult males so that by 1850, this ratio had risen to almost 90 percent of the level it maintained between 1885 and 1960, when it was generally stable.

It should not be surprising that northern manufacturers were initially quick to adopt production methods that relied extensively on the employment of women and children. The low relative productivity of these workers in the North's agricultural sector, where hay, dairy goods, and grains were the major products, had established a relatively low opportunity cost for their labor as compared to that in the South. Indeed, this regional difference may partially account for why manufacturing industries were disproportionately concentrated in the North during this period.[4] Wherever the manufacturing sector expanded in that region, the wages of women and children were bid up substantially,

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intermediate stage between the mechanized factory using water power and handwork done at home was the shop that brought together a large number of handworkers. Here there could be minute division of labor, hence a decreasing need for general skill, and constant supervision could ensure a more reliable volume of production (p. 57)."

[4] This issue is discussed below in section III, but receives a more extensive treatment in Claudia Goldin and Kenneth Sokoloff, "The Relative Productivity Hypothesis of Industrialization: The American Case, 1820–1850," *Quarterly Journal of Economics* (forthcoming).

both in absolute terms and relative to those of males. As a consequence, the rate of labor force participation of these groups rose dramatically. Thus the first half of the nineteenth century was a critical juncture in the evolution of both female participation in the market economy and the relative wage of females in the manufacturing sector.

In a related paper, we develop a simple general equilibrium model that more formally integrates some of the changes that are documented in this article.[5] While we shall not discuss the details of this model here, references are made to them. We have the following sort of model in mind throughout our analysis. Consider the simplest of all variants of a general equilibrium model: a two-sector (agriculture and manufacturing), two-input (female plus child labor and adult male labor) model, in which agriculture is relatively intensive in male labor at all factor price ratios, and endowments and output prices are exogenously determined. Initially, perhaps around 1800 before the growth of large manufacturing establishments, the relative wage for women (and children) compared to that for adult men was quite low. The productive potential in the manufacturing sector of female (and child) labor, which might have differed from male labor in terms of skill, experience, dexterity, strength, or cultural norms, had not yet been fully explored or developed. During the period, say from 1810 to 1830, the range of alternative production techniques was extended and the size of the manufacturing sector expanded, leading to increases in the proportion of females employed in manufacturing, the proportion of the manufacturing labor force that was female, and the relative wage of females ($w_f/w_m$). Over the next several decades, the more rapid growth of the female-intensive manufacturing sector, perhaps because of neutral technological change or shifts in demand, continued to exert upward pressure on ($w_f/w_m$) and on the labor force participation rates of females, but the female share of the manufacturing labor force began to decline.

The virtue of this compact model is that it provides an analytically convenient way to understand the impact of the relative expansion of the female-intensive manufacturing sector, as compared to the other, agricultural sector, on factor prices and on the factor proportions employed in each sector. This analytical convenience, however, is obtained at the cost of a number of simplifications. Among the most serious of these are the treatment of only two inputs, the assumption that all manufacturing industries are alike in terms of their technologies, and the positing of distinct stages in industrial development. In actuality, capital was an important input and manufacturing industries were considerably diversified in their technologies. Not all industries experienced the transition from the small (male-intensive) shops to the larger

[5] Goldin and Sokoloff, "The Relative Productivity Hypothesis."

(female-intensive) factories, and even among those that did, the development occurred at different rates across industries and areas of the Northeast. This pattern of diffusion was not only a function of differences between industries in technological innovation, but also of variation over time and space in factors not accounted for in the model, such as capital market conditions and the extent of product markets.

In our investigation of the role of women and children in the early industrial labor force, we have relied extensively on samples drawn from the schedules of three of the period's censuses of manufacturing: the 1820 Federal Census of Manufactures; a survey of manufacturing firms in 1832 conducted by the Treasury Department, known as the *McLane Report*; and the 1850 Federal Census of Manfactures.[6] The widely-held notion that the early censuses of manufacturing were markedly deficient has long discouraged scholars from fully exploiting these sources; although they have been utilized heretofore, it is only recently that they have been sampled systematically.[7] It is our view that while the 1820 census and the *McLane Report*, in particular, have some serious flaws, their overall value has been vastly underrated.

## II

No detailed record of American growth exists for the period prior to 1840. Nevertheless, there is a firm basis for the view that industrializa-

[6] U.S. House of Representatives, *Documents Relative to the Statistics of Manufactures in the U.S.*, 2 Vols., Serial Set Numbers 222 and 223 (Washington, D.C., 1833), is commonly, and will be henceforth, referred to as the *McLane Report,* after the then Secretary of the Treasury, Louis McLane. Each of the three data sets has problems that complicate the analysis. Among the most serious defects are the quality of the coverage differed substantially by geographic region and that small manufacturing establishments are underrepresented (in nearly all areas) in the 1820 and 1832 data. These sample selection biases prevent a straightforward calculation of aggregate totals, but allow the computation of averages for classes of manufacturing firms, and a re-weighting of them to arrive at manufacturing sector averages. Another of our concerns is that the categories of information on employees and their wages reported vary from census to census (or survey in the case of the *McLane Report*). In the 1820 census, adult males and females were enumerated apart from children, often separately listed as boys and girls. However only a total (annual) wage bill was given. The 1832 *McLane Report* generally listed adult males separately from boys less than 17 years old, but grouped females of all ages together. Although coverage and detail varied considerably by state, wages in the *McLane Report* were typically given as an average daily (or weekly) wage for each class of employees. The 1850 census distinguished only between males of all ages and females of all ages, and reported the average monthly wage for each group. For further information concerning the 1820 and 1832 samples, see Kenneth L. Sokoloff, "Industrialization and the Growth of the Manufacturing Sector in the Northeast, 1820–1850," unpublished Ph.D. dissertation, Harvard University, 1982.

[7] For example, Lebergott, *Manpower in Economic Growth,* used the wage data in the *McLane Report,* and Alfred Chandler, *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, Massachusetts, 1977), employed the data on large enterprises from that manufacturing survey. See Fred Bateman and Thomas Weiss, *A Deplorable Scarcity: The Failure of Industrialization in the Slave Economy* (Chapel Hill, North Carolina, 1981), for a discussion of the collection and analysis of their sample of firm data from the 1850 census.

tion got underway during the early decades of the nineteenth century. The available evidence indicates that these years marked the onset of a sharp rise in the share of the labor force primarily engaged in the non-agricultural sectors of the economy, particularly in the northeastern states.[8] Important changes in the operations of this region's manufacturing establishments are also manifest. The emergence of large, integrated, and mechanized plants in the cotton and wool textile industries is perhaps the best known example of the advances over traditional methods of manufacture that were introduced during the period, but the increases in firm size, capital intensity, and labor productivity that were registered by many other, generally non-mechanized industries between 1820 and 1850 suggest that innovation in the manufacturing sector was widespread.[9] The transition to the small factory may seem a modest advance when compared to the technological progress in textile production, but its significance is perhaps more reasonably gauged by contrasting the factory with the traditional artisanal shop that was displaced.

Investigation of the composition of the manufacturing labor force during this critical phase of industrialization has long been hampered by a lack of evidence. Previous work has referred to the prominence of women and children in particular industries and regions, but comprehensive estimates of the representation of these groups in the industrial labor force and its correlates could not be undertaken without new sources of information such as the samples of manufacturing firm data. These bodies of evidence reveal that women and children came to comprise a large proportion of all manufacturing employees in the Northeast quite early and swiftly during the first half of the nineteenth century. Our estimates, presented in Table 1, suggest that their fraction of the manufacturing labor force in the Northeast had already exceeded

[8] The proportion of the labor force employed in agriculture can be computed for 1820, 1840, and 1850 from information contained in U.S. Department of State, *Census for 1820* (Washington, D.C., 1821); U.S. Department of State, *Sixth Census or Enumeration of the Inhabitants of the United States* (Washington, D.C., 1841); and U.S. Census Office, *A Compendium of the Seventh Census* (Washington, D.C., 1854). The figures are reported below and they indicate that the share of the labor force in agriculture was shrinking after 1820, if not before. They are flawed in some respects, however, and thus provide only rough estimates.

| | *Proportion Of The Labor Force Employed In Agriculture* | |
|---|---|---|
| | *Middle Atlantic* | *New England* |
| 1820 | .74 | .73 |
| 1840 | .65 | .61 |
| 1850 | .34 | .33 |

Although the 1820 and 1840 censuses were designed to include men, women, and children in their labor force estimates, the 1850 data were explicitly confined to males over the age of 15.

[9] Most manufacturing industries, both mechanized and non-mechanized, appear to have realized significant gains in average firm size, the capital to labor ratio, and labor productivity between 1820 and 1850. See Sokoloff, "Industrialization and the Growth of the Manufacturing Sector," Chapters 2, 3, and 4.

30 percent by 1820 and still remained over that level in 1850, while achieving an historical peak in the vicinity of 40 percent sometime between those years.

After cresting near 40 percent, the share of the industrial labor force in the Northeast composed of women and children began a secular decline which continued into the second half of the century. As the decrease was gradual, and there are only a few years for which we can compute estimates, neither the timing of the peak nor that of the subsequent decline can be precisely identified. The likelihood that the peak occurred during the late 1830s or early 1840s, however, is perhaps best illustrated by focusing on the proportions of the manufacturing labor force composed of females of all ages reported in Table 1. In the Northeast as a whole, females are estimated to have constituted 32.7 percent of manufacturing workers in 1832, but this percentage had dropped to 28.8 percent by 1850.[10] A similar pattern is apparent in Massachusetts, where a state census provided the data for our 1837 figure. In that state, the share of the labor force comprised of females seems likely to have peaked sometime between 1837 and 1850, whether or not one includes home workshop production.

Whereas all other figures in Table 1 have been computed in a straightforward manner, those reported for the Northeast in 1820 and 1832, perhaps the most critical years to our findings, are drawn from a set of estimates. These estimates have been constructed by varying several assumptions about the severity of particular sample selection biases that afflict the underlying sources. Extensive sensitivity tests indicate that the qualitative results are not affected by variations in these assumptions over a plausible range.[11]

[10] The 1850 figure is 28.8 percent if one includes the workers classified as "clothiers and tailors," but drops to 24.1 percent if one does not. Clothiers and tailors seem to have been overcounted in 1850 relative to both the 1832 *McLane Report* and the 1860 census, and it seems likely that home sewers were included in the 1850 figures. See note (d) to Table 1 for further information.

[11] The 1820 and 1832 proportions of the manufacturing labor force composed of women and children were estimated by weighting the proportions of particular categories of firms, to adjust for potential biases. Our method uses the definition

$$P_f = \sum_j \sum_i S_j X_{ji} I_{ij},$$

where $P_f$ is the aggregate proportion of the manufacturing labor force that is female, $S_j$ is the percentage of the total manufacturing labor force employed in firms of size class j, $X_{ji}$ is the percentage of the labor force in size class j working in industry i, and $I_{ij}$ is the percentage of the labor force in firms of industry i and size class j that is female. The under-enumeration of small firms in both 1820 and 1832 is reflected in biased $S_j$s and $X_{ji}$s. We have assumed that the observed $I_{ij}$s are unbiased, but have varied the assumptions about the other weights.

The sample of firms from the 1820 Census of Manufactures was drawn from randomly selected counties. Since the omission of firms from the census was apparently a function of their size rather than industry, it seems reasonable to assume that the sample $X_{ji}$s are unbiased, but that the $S_j$s are biased by the under-enumeration of small establishments. The Table 1 estimate uses a conservative assumption about the $S_j$ distribution, that 40 percent of the labor force was in the small category (1 to 5 workers), 40 percent in the medium (6 to 15 workers), and 20 percent in the large category. Assuming an equal division of the labor force among size classes (33.3 percent in each) gives 10.6

TABLE 1
FEMALE AND CHILD WORKERS AS A PERCENTAGE OF ALL WORKERS IN MANUFACTURING: 1820 TO 1890

| | *Entire U.S. or Northeast* | | | *Massachusetts* | | |
|---|---|---|---|---|---|---|
| | *Females* | | *Children Boys and Girls [Boys]* | *Females* | | *Children Boys and Girls [Boys]* |
| *Year* | *All Ages* | *> 15 Years* | | *All Ages* | *> 15 Years* | |
| 1820 Northeast[a] | | 8.9 | 23.1 | | | |
| 1832 Northeast[b] | 32.7 | | [7.6][e] | (38.4–47.5)[f] | | [9.3][e] |
| 1837 | | | | (41.6–49.0)[f] | | |
| 1850 Northeast[c] | 28.8(24.0)[d] | | | | | |
| 1850 U.S.[c] | 24.7(20.1)[d] | | | 39.3 (36.2)[d] | | |
| 1860 Northeast[c] | 28.0 | | | | | |
| 1860 U.S.[c] | 21.1 | | | 35.9 | | |
| 1870 U.S. | | 15.8 | 5.6 | | 30.9 | 5.1 |
| 1880 U.S. | 21.4 | 19.5 | 6.7 | 32.0 | 30.1 | 5.0 |
| 1890 U.S. | 18.7 | 18.0 | 2.6 | 29.3 | 28.6 | 1.8 |

[a] In calculating these estimates we assumed that, within size categories of firms, the distribution of the labor force among the industries was correct, but made adjustments for the underenumeration of small firms (or the unrepresentative distribution of the labor force among size categories). Instead of accepting the figures from the sample of 14 percent of the labor force in the small category (1 to 5 employees), 23 percent in the medium (6 to 15 employees), and 64 percent in the large (over 15 employees), we employed 40 percent, 40 percent, and 20 percent in the respective size classes to prepare the reported estimate. See footnote 11 for further information.

[b] These estimates were computed under the assumption that the same proportion of children working for firms that failed to enumerate them separately by sex were female, as was the case with those children working for firms of the same industry and size class that did enumerate them separately. The same method of adjusting for the underenumeration of small firms that was used in calculating the 1820 estimates has been employed here. We assumed that 25 percent of the labor force was employed by small firms, 25 percent by the medium-sized firms, and 50 percent by the large firms. The distribution observed in the 1850 sample of firms, which underrepresents large firms, is 18 percent, 15 percent, and 68 percent in the respective size categories. See footnote 11 for further information.

[c] The 1850 figures for New England and the Middle Atlantic are 37.0 and 22.2, respectively; comparable figures for 1860 are 35.2 and 22.4. Employment in fisheries, mines, and quarries has been excluded for comparability with other years.

[d] The numbers in parentheses exclude clothiers and tailors, a category that was undoubtedly undercounted in 1832. The 1860 Census of Manufactures was the first to include a category for a clothing industry. The figures for 1860 indicate only a slight rise in total employment in clothing from 1850, when only clothiers and tailors were counted, to 1860, thus raising the possibility that the 1850 figures overcounted home sewers.

[e] These figures include only boys.

[f] The first figure includes only manufacturing workers in shops and factories; that is, it excludes fisheries and palm leaf and straw hat workers. The second figure includes palm leaf and straw hat workers. The number of these workers is given by: L = [V(2/3)/90] where V is the value of output in this industry. This calculation is explained in Table 9, notes to column (4). These figures slightly understate the percentage female, because small industries did not enumerate employees by sex. It was assumed, however, for the case of printed cloth that women were 75 percent of the labor force, which was their percentage in cotton textiles. Workers in the fishing and whaling industry were not included in the total figures.

Notes: The term "children" was used in the 1820 Census of Manufactures without a clear definition. In several cases enumerators indicated that they included children up to 17 years old in this category. The 1870 through 1890 censuses make clear that "children" meant boys ≤ 16 years and girls ≤ 15 years. There has been much confusion over the 1850 and 1860 returns, but the manuscripts of the 1850 Census of Manufactures imply that "all females" and "all males" were the categories used. We have used these definitions despite the fact the the U.S. Census Office, *Tenth Census of the United States: 1880. Report on the Manufactures of the United States at the Tenth Census*, Vol. 2 (Washington, D. C., 1883) reports that the 1850 and 1860 Censuses counted only adults. The 1880 and 1890 figures for females of all ages are based on the assumption that 28.9 percent of all children in manufacturing were female. Those for Massachusetts are based on 38.8 percent. These percentages were derived from information reported in the U.S. Census Office, *Report on the Manufactures of the United States at the Tenth Census*, p. xxx.

Sources: 1820: Sample of firms from the schedules of the Federal Census of Manufactures.
1832: Sample of firms from the schedules of the *McLane Report*.
1837: John P. Bigelow, *Statistical Tables Exhibiting the Conditions and Products of Certain Branches of Industry in Massachusetts for the Year 1837* (Boston, 1838).
1850: U. S. Census Office, *Abstract of Statistics of Manufactures, According to the Returns of the Seventh Census* (Washington, D. C., 1858).
1860: U. S. Census Office, *Eighth Census of the United States: 1860. Manufactures of the United States in 1860* (Washington, D. C., 1865).
1870: U. S. Census Office, *Ninth Census of the United States: 1870. The Statistics of the Wealth and Industry of the United States*, Vol. 3 (Washington, D. C., 1872).
1880: U. S. Census Office, *Report on the Manufactures of the United States at the Tenth Census*, pp. 5–8.
1890: U. S. Census Office, *Eleventh Census of the United States: 1890. Report on the Manufacturing Industries in the United States*, Vol. 6 (Washington, D. C., 1895).

Comparable labor force estimates cannot be constructed for females and children in the pre-1820 economy. Nevertheless, it seems likely that their prominence in the manufacturing labor force around 1820 was a recent development. Women and children may have been engaged in household manufacturing, but as will be seen in Table 3, few seem to have labored in the small manufacturing firms (typically with fewer than 6 workers) that generally characterized the proto-industrial economy. Larger enterprises were not established in significant numbers until the burst of industrial expansion ushered in by the Embargo of 1807 and the War of 1812, and it was probably during this period that the proportion of manufacturing workers composed of females and children began to increase substantially.[12]

Cotton and wool textiles were among the first manufacturing industries to experience rapid rates of increase in output during the early nineteenth century. It should thus not be surprising that the growth of these two industries, both known to utilize female and child labor intensively, accounted for much of the initial increase in the employment of these groups. Indeed, in 1820, not long after industrial expansion had begun, nearly 70 percent of the adult females in the manufacturing sector labored in the textile industries (as indicated in Table 2). The concentration of females and children in textiles does not, however, indicate that firms in other industries had labor forces that were composed almost exclusively of adult men. It reflects, instead, the large share of the total industrial labor force accounted for by cotton and wool textiles. As industrialization proceeded, other manufacturing industries grew relative to textiles, reducing the proportion of female workers in textiles to 34 percent by 1850.[13]

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percent of the manufacturing labor force composed of adult females and 25.0 percent composed of children. A very extreme assumption of 25 percent, 25 percent, and 50 percent in the respective classes yields 12.8 percent adult females and 27.4 percent children.

The sample drawn from the *McLane Report* overrepresents firms from New England, particularly Massachusetts, and therefore it is likely that both the $X_{ji}$s and the $S_j$s are biased. To check the sensitivity of our estimates, we have varied the assumptions about both distributions. The 1832 estimate in Table 1 is based on the sample $X_{ji}$s and an assumption that 25 percent, 25 percent, and 50 percent of the labor force were employed in the respective size classes. An assumption of 33.3 percent in each class yields an estimate of 26.7 percent females and 7.6 percent boys; an assumption of 18 percent, 15 percent, and 68 percent (the distribution observed in the 1850 sample), yields 38.9 percent females and 8.0 percent boys. Changing the $X_{ji}$s to those observed in 1850 and keeping the $S_{ij}$s also at their 1850 levels, yields 26.8 percent females and 7.7 percent boys. Using 25 percent, 25 percent, and 50 percent, for the $S_j$s, but taking the $X_{ji}$s from 1850 yields 22.6 percent females and 7.8 percent boys. Since several of the highly female-intensive industries, such as textiles, were in relative decline by 1850, this latter estimate is substantially biased downward.

[12] See, for example, Arthur H. Cole, *The American Wool Manufacture*, 2 vols. (Cambridge, Massachusetts, 1926); Blanche Hazard, *The Organization of the Boot and Shoe Industry in Massachusetts Before 1875* (Cambridge, Massachusetts, 1921); and Caroline F. Ware, *The Early New England Cotton Manufacture: A Study in Industrial Beginnings* (Boston, 1931).

[13] As shown in Table 2, even Massachusetts, the textile center of the United States, experienced a decline in the proportion of all employed females in manufacturing working in textiles, from 48 percent in 1837 to 36 percent in 1850.

TABLE 2
INDUSTRIAL DISTRIBUTION OF FEMALE MANUFACTURING WORKERS: 1820 TO 1890

| | | *Industry* | | | | |
|---|---|---|---|---|---|---|
| | | *Textiles* | | | | *Age Category of* |
| *Year* | *Region* | *Cotton* | *Wool* | *Clothing* | *Other* | *Included Females* |
| 1820 | Northeast | 58.1% | 11.8% | 2.4% | 27.7% | Adults |
| 1837 | Massachusetts | 39.5 | 8.6 | 7.8 | 44.1 | All ages |
| 1850 | Massachusetts | 29.1 | 7.0 | 18.3 | 45.6 | All ages |
| 1850 | Northeast | 27.1 | 7.1 | 31.0 | 34.8 | All ages |
| 1850 | U. S. | 38.5 | | 34.9 | 26.6 | All ages |
| 1860 | U. S. | 40.7 | | 33.5 | 25.8 | All ages |
| 1870 | U. S. | 39.1 | | 28.6 | 32.3 | All ages |
| 1880 | U. S. | 38.5 | | 32.2 | 29.3 | > 15 years |
| 1890 | U. S. | 32.2 | | 34.3 | 33.5 | > 15 years |

Sources: 1820: Sample of firms from the schedules of the Federal Census of Manufactures.
1837: Bigelow, *Industry of Massachusetts.*
*1850: U.S. Census Office, Abstract of Statistics of Manufactures, According to the Returns of the Seventh Census.*
1850 to 1890: Helen Sumner, *History of Women in Industry in the United States: Report on Conditions of Women and Child Wage-earners in the United States,* Vol. 9, 61st Congress, 2nd Session, Senate Document No. 645 (Washington, D. C., 1910), p. 250.

Notes: Sumner's 1850 to 1890 clothing employee figures were revised to exclude workers in boots and shoes, umbrellas, and pocketbooks. All the clothing figures include workers in hats and caps, but workers in straw bonnets and palm leaf hats have been excluded from the 1837 Massachusetts figures. As noted in the text, the 1820 Census of Manufactures had poor coverage of manufacturing firms in some areas and generally underenumerated small establishments. Since small firms employed few females, their underrepresentation should not greatly bias these figures.

Work forces of other prominent industries of this period (for example, boots and shoes, paper) were also heavily weighted toward females and children, although somewhat less so than textiles. In 1850, for example, females alone amounted to 30 percent of the nation's workers in manufacturing industries as diverse as boots/shoes, brushes, buttons, carpets, clothiers/ tailors, gloves, hats/caps, matches, paper, perfumes/ soap, rubber goods, surgical instruments, textiles (cotton and wool), umbrellas, and whips/canes.[14] Thus, the high proportion that women and children comprised of manufacturing workers was not merely a product of employment in one or two industries, and it continued for some time in the face of a relative decline of textiles among all manufacturing industries.

The estimates (by industry and size of firm) of the percentage of manufacturing employees that were women or children presented in Table 3 provide further evidence that these groups were a major

[14] This is not a comprehensive list of all manufacturing industries in which 30 percent of the workers in 1850 were female. The problem of underenumeration of small firms in the 1820 census and the 1832 *McLane Report* prevents us from calculating precise estimates, at the industry level, of the proportion of the labor force composed of women and children in those years. To illustrate that these classes of workers were prominent in many industries, we present the raw figures

component of the labor force in many industries other than textiles, especially in larger establishments. Among the establishments in the larger size class (over 15 workers), roughly 54 percent of the employees were women or children in 1820, 59 percent were in 1832, and at least 30 percent were in 1850. Even excluding the four industries listed separately in Table 3, each of which relied extensively on female and child labor, women and children continue to account for well over 20 percent of the workers in each of the three years.

The data also suggest that, within industries, as the size of a firm or its scale of production increased, so did the proportion of the firm's work force made up of women and children. In the 1850 boots and shoes industry, for example, only 6.9 percent of the workers in small firms (1 to 5 workers) were female, while 23.2 percent and 39.9 percent of those in intermediate (6 to 15 workers) and large size classes respectively were. Only a few industries do not conform to this general pattern. Although one might question whether the observed relationship between size of firm and labor composition is a product of other variables correlated separately with these, the regressions appearing in Table 4 indicate otherwise. Even after controlling for variables such as region, level of urbanization, and industry, the size of a firm remains a powerful predictor of the proportion of its labor force composed of women and children. The coefficient on the log of the number of employees is significant to the 1 percent level in each of the three samples of manufacturing firms (1820, 1832, and 1850) analyzed.

The finding that larger firm size was associated in many industries with a higher proportion of female and child employees suggests that the displacement of artisanal shops by establishments organized as factories served to increase the share of these groups in the manufacturing labor force. This statistical relationship indicates some of the consequences of the spread of the factory system, and also bears on why such methods of production were increasingly adopted during the early phase of industrialization. Advances in mechanization are frequently acknowledged to have contributed to the rise of the factory and the increased employ-

(unadjusted for sample selection bias) for selected industries:

*Percentage of Women and Children Among All Employees in the Northeast*

| *Industries* | *1820* | *1832* |
|---|---|---|
| Boots and Shoes | 27.8% | 46.2% |
| Domestic Goods (i.e., candles, soap) | 22.2 | 28.6 |
| Fine or Precision Goods (i.e., clocks, jewelry) | 28.5 | 38.9 |
| Glass | 8.5 | 19.5 |
| Hats | 26.2 | 19.0 |
| Iron Goods | 12.0 | 18.7 |
| Other Metal Goods | 19.1 | 12.1 |
| Paper | 57.0 | 39.4 |
| Tobacco (i.e., cigars, snuff) | 66.5 | 83.5 |

TABLE 3
PROPORTION OF FEMALES AND CHILDREN IN THE NORTHEASTERN LABOR FORCE BY SIZE OF FIRM FOR SELECTED INDUSTRIES: 1820, 1832, AND 1850

| | *Size of Firm* | | | | | |
|---|---|---|---|---|---|---|
| | *Small* | | Medium | | Large | |
| | *(1 to 5 Employees)* | | *(6 to 15 Employees)* | | *(≥ 16 Employees)* | |
| *1820* | *Percent Females* | *Percent Children [% Boys]* | *Percent Females* | *Percent Children [% Boys]* | *Percent Females* | *Percent Children [% Boys]* |
| Cotton Textiles (52.1%) | 27.8 | 16.7 | 32.4 | 46.4 | 28.9 | 50.2 |
| Wool Textiles (12.5%) | 4.5 | 15.0 | 17.0 | 37.3 | 19.3 | 41.1 |
| Boots and Shoes (2.2%) | 16.7 | 5.6 | 21.1 | 11.8 | 21.0 | 6.0 |
| Paper (5.6%) | — | — | 19.1 | 36.1 | 36.8 | 23.5 |
| Other (27.6%) | 0.9 | 11.8 | 4.7 | 22.5 | 6.7 | 20.4 |
| Total (100.0%) | 1.7 | 12.2 | 11.1 | 28.2 | 19.1 | 34.6 |
| *1832* | | | | | | |
| Cotton Textiles (57.5%) | — | — | 75.2 | [6.1] | 74.0 | [6.7] |
| Wool Textiles (14.6%) | 10.1 | [17.8] | 30.7 | [14.8] | 47.2 | [8.8] |
| Boots and Shoes (12.9%) | 25.0 | [3.1] | 30.3 | [9.7] | 44.5 | [11.3] |
| Paper (1.6%) | 10.5 | [2.6] | 40.6 | [3.0] | 53.2 | [4.7] |
| Other (13.5%) | 1.9 | [5.5] | 11.9 | [6.4] | 18.7 | [7.5] |
| Total (100.0%) | 5.1 | [6.4] | 24.4 | [8.2] | 50.7 | [7.8] |
| *1850* | | | | | | |
| Cotton Textiles (27.1%) | 13.7 | | — | | 65.5 | |
| Wool Textiles (8.0%) | 23.5 | | 30.1 | | 42.5 | |
| Boots and Shoes (15.9%) | 6.9 | | 23.2 | | 39.9 | |
| Paper (1.2%) | 7.0 | | 18.6 | | 60.4 | |
| Other (47.8%) | 2.8 | | 6.0 | | 16.4 | |
| Total (100.0%) | 3.7 | | 10.1 | | 28.1 | |

Notes and Sources:

These percentages were computed from the samples of manufacturing firms drawn from the 1820 and 1850 Censuses of Manufactures and the 1832 *McLane Report*. The figures in parentheses report the unadjusted percentages of female and child workers (only females in 1850) in the respective industries. In the 1820 figures, "females" include only adult women, probably over 17 years. In the 1850 figures, "females" include those of all ages. *McLane Report* enumerators typically grouped females of all ages in a separate category, although some firms reported boys and girls together. The above figures were computed by assuming that firms that combined boys and girls had the same ratio of girls to boys as did other firms in the same industry and size class. Thus the 1832 "children" percentages should be interpreted as the percentages of boys, not all children.

The *McLane Report* generally undercounted small manufacturing firms, and this sample selection bias was especially severe for New York and Rhode Island, in which establishments other than large-scale textile firms were virtually excluded. As a consequence, the size distribution of firms from our 1832 sample is skewed toward the larger firms, and textile firms are over-represented. These biases however, do not necessarily affect the figures reported in this Table, which is stratified by both size class and industry. Due evidently to both its underenumeration of firms in some female-intensive industries and the complete omission from it of Rhode Island firms, the 1850 sample implies a lower female share of the manufacturing work force than the aggregate figures from the 1850 Census of Manufactures do. This is why each of the size class proportions (of the employees that are female) reported for 1850 here is less than the 1850 aggregate figure cited in Table 1.

TABLE 4
REGRESSIONS OF THE FEMALE AND CHILD SHARE OF MANUFACTURING WORKERS ON FIRM CHARACTERISTICS: 1820, 1832, AND 1850

| | *1820* | *1832* | *1850* |
|---|---|---|---|
| | *(Females + Boys)* | *(Females + Boys)* | *Females* |
| | *Number of Employees* | *Number of Employees* | *Number of Employees* |
| Intercept | 0.296 | 0.223 | 0.136 |
| | (7.15) | (5.31) | (5.00) |
| Log (% of County Population | −0.003 | 0.018 | 0.008 |
| Residing in Urban Area) | (−0.84) | (1.92) | (1.22) |
| Log (Number of Employees) | 0.088 | 0.067 | 0.058 |
| | (12.57) | (10.92) | (16.58) |
| New England Dummy | 0.029 | 0.035 | 0.038 |
| | (1.76) | (1.94) | (4.90) |
| Industry Dummies: | | | |
| Cotton | 0.179 | 0.310 | 0.136 |
| | (4.30) | (7.86) | (3.39) |
| Wool | −0.092 | 0.013 | |
| | (−2.23) | (0.34) | |
| Iron | −0.475 | −0.386 | −0.275 |
| | (−9.66) | (−8.93) | (−7.70) |
| Iron Products | | −0.232 | |
| | | (−3.84) | |
| Tanneries | −0.194 | −0.225 | −0.206 |
| | (−4.64) | (−5.50) | (−6.74) |
| Mills | −0.297 | −0.239 | |
| | (−6.64) | (−3.98) | |
| Harnesses and Coaches | | −0.218 | |
| | | (−4.63) | |
| Shoes | | 0.016 | −0.109 |
| | | (0.39) | (−4.01) |
| Household Goods | | | −0.210 |
| | | | (−7.01) |
| Perishables | | | −0.167 |
| | | | (−5.14) |
| Construction | | | −0.201 |
| | | | (−7.47) |
| Hand Trades | | | −0.190 |
| | | | (−6.78) |
| Miscellaneous | −0.190 | −0.166 | −0.146 |
| | (−5.70) | (−4.55) | (−5.62) |
| $R^2$ | 0.561 | 0.605 | 0.325 |
| Number of Firms | 1036 | 940 | 1652 |

Notes and Sources:

The intercept, for the 1820 and 1832 regressions, represents a paper mill in the Middle Atlantic. The 1850 intercept reflects a Middle Atlantic firm in the wool industry. T-statistics appear in parentheses, below the corresponding regression coefficients.

These regressions were estimated across all firms in the 1820, 1832, and 1850 samples that reported the necessary information. The definition of the dependent variable and the set of independent variables varied somewhat from census to census. The 1850 regression uses [females/employees] as the dependent variable because boys were not separately enumerated from men, and each regression uses a different set of industry dummies. Several statistically insignificant industry dummies included in the 1820 regression have been omitted.

ment of females and children, but many non-mechanized industries also experienced similar changes in firm organization and labor force composition.[15] Habakkuk has argued that the diffusion of the new technologies was at least partially the outcome of vigorous efforts by American manufacturers to conserve on male labor. But as he recognized, the means of accomplishing this goal included not only the substitution of capital for labor, but also the use of available labor supplies more intensively by increasing the pace of production and the substitution of a relatively cheap class of workers for an expensive one.[16]

The relationship between firm size and the employment of women and children within industries indicates that the diffusion of new, large-scale technologies was associated with the substitution of women and children for men. In some industries, such as textiles and paper, these new technologies were highly capital intensive. But firms in other industries seem to have altered their production methods by utilizing a more extensive division of labor without significantly increasing capital intensity.[17] The separation of tasks within the firm appears to have occurred across a wide range of industries, and studies of industries as dissimilar as glass and shoes have suggested that such changes in work organization were introduced to economize on costly skilled labor:

> When window glass was first manufactured in the United States, it was customary not only for the blower to gather his own glass but also to blow, cut, and flatten it. In 1820 this was still common in many of the smaller factories. Those operated on a larger scale frequently had assistants or apprentices who relieved the blowers of certain of the more minor and unskilled steps of the process. In time the division of labor was greatly elaborated; four separate trades eventually emerged from the process of making cylinder window glass.[18]

> He [Gideon Howard, a manufacturer of shoes in South Randolph, Massachusetts] had a "gang" over in his twelve-footer who fitted, made and finished: one lasted, one pegged and tacked on soles, one made fore edges, one put on heels and "pared them up," and in

[15] Sokoloff, "Industrialization and the Growth of the Manufacturing Sector," Chapter 2.

[16] All three of these ways of saving on a scarce factor of production were discussed by Habakkuk in his *American and British Technology*. The ensuing debate on his work, however, focused solely on the substitution of capital for labor, in spite of Habakkuk's clear acknowledgment of there having been several classes of labor, some of which were associated with the use of capital (see p. 65 in particular). For examples of the debate, see Peter Temin, "Labor Scarcity and the Problem of American Industrial Efficiency in the 1850s," this JOURNAL, 26 (Sept. 1966), 277–98, and Robert W. Fogel, "The Specification Problem in Economic History," this JOURNAL, 27 (Sept. 1967), 283–308.

[17] Regressions of the log (fixed capital/value added) across our 1832 firms indicate that only in textiles (wool and cotton) and paper was capital intensity significantly and positively related to the percentage of the labor force composed of women and children and to the total size of the labor force (constructed as a weighted average of the three classes of labor). When the regression is estimated without industry dummy variables, the coefficients on both the labor force variable and the percentage of employees that were women and children are significantly negative.

[18] Pearce Davis, *The Development of the American Glass Industry* (Cambridge, Massachusetts, 1949), p. 48.

case of handsewed shoes, two or three sewers were needed to keep the rest of the gang busy . . . these groups of men in a ten-footer gradually took on a character due to specialization demanded by the markets with higher standards and need of speed in output. Instead of all the men working there being regularly trained shoemakers, perhaps only one would be, and he was a boss contractor, who took out from a central shop so many cases to be done at a certain figure and date, and hired shoemakers who had "picked up" the knowledge of one process and set them to work under his supervision. One of the gang was a laster, another a pegger, one an edgemaker, one a polisher. Sometimes, as business grew, each of these operators would be duplicated. Such work did away with the old seven-year apprenticeship system.[19]

Because females and boys were generally enumerated separately from adult males, the substitution of women and children for men in the larger establishments may only be one easily observed aspect of a more general phenomenon, the substitution of unskilled labor for skilled labor. The small manufacturing shops of the period typically consisted of a few artisans, perhaps with an apprentice, and the limited division of labor within such firms allowed only a small fraction of their employees to be unskilled. Larger firms were more likely to have implemented an organization of work that involved a separation of tasks and allotted a greater share of positions to unskilled workers. The definition of "unskilled" is a matter of degree, and it is perhaps an over-simplification to use sex and age as proxies for skill.[20] While women and children did accumulate skills on the job, their limited job training, actual and anticipated in the case of females, led them to acquire fewer skills than adult men did. Indivisibilities associated with the application of a supervisory input may also have contributed to the increase in females and children with the scale of firms. The productivity of these laborers, particularly the young, could have been disproportionately affected by the implementation of measures aimed at ensuring a disciplined work regime such as the use of piece-rate wages or the addition of supervision.[21]

## III

We have argued that the initial phase of industrialization in the United States was characterized not only by a great expansion of the manufac-

[19] Hazard, *The Organization of the Boot and Shoe Industry*, pp. 85–86.

[20] Sex and age are not merely proxies for skill, they are also proxies for opportunity costs. For a more extensive discussion of this topic see Goldin and Sokoloff, "The Relative Productivity Hypothesis," and for a caution about the use of sex as a proxy for skill see Pamela J. Nickless, "A New Look at Productivity in the New England Cotton Textile Industry, 1830–1860," this JOURNAL, 39 (Dec. 1979), 889–910.

[21] While much of the literature on the role of the factory has stressed the importance of machines in accounting for the increase in the scale of firm from cottage industry, another segment has pointed to the role of discipline and supervision. Stephen Marglin, "What Do Bosses Do? The Origins and Functions of Hierarchy in Capitalist Production," *Review of Radical Political Economics*, 6 (Summer 1974), 33–60 is the best source on this point.

turing sector in the Northeast, but also by a shift to the factory system and toward technologies utilizing an extensive division of labor within the firm. Why both of these developments occurred during the early nineteenth century is an issue of great complexity and beyond the scope of this work. But it is clear that many factors, such as technological change, economies of scale, tariffs, falling transport costs, and increasingly efficient capital markets could each have played a role.[22] Whatever the events that served to stimulate the shift toward large-scale production methods, one would expect them to have increased the demand for female and child workers relative to that for adult males. In a two-sector model, in which output prices and endowments are exogenous, such a change in demand conditions would lead to an increase in the relative wages of female and child workers. The more rapid expansion of the female and child-intensive manufacturing sector, as opposed to the agricultural sector, would also have tended to raise the relative rates of compensation for women and children.[23]

A sufficient amount of information has now been retrieved for us to explore the movement of wage rates during the first half of the nineteenth century.[24] While we have some data bearing on agricultural wage rates prior to industrialization, our best evidence on the pre-industrial period comes from the commentary of those who lived through those transitionary times. Bodies of evidence such as the samples of manufacturing firm data enable us to compute estimates of the ratio of the female wage to that of adult males at several points during the early industrialization of the Northeast. While other sources of wage data exist for certain industries, these samples from the censuses make it possible to estimate the average rates for the entire manufacturing sector. All of the evidence we have located indicates that the wage rates reported by firms in our 1832 and 1850 samples represent

[22] For two recent, but different, views on the causes of industrial expansion and of regional variation in industrialization see Alexander Field, "Sectoral Shift in Antebellum Massachusetts: A Reconsideration," *Explorations in Economic History*, 15 (Apr. 1978), 146–71, and Robert Brooke Zevin, *The Growth of Manufacturing in Early Nineteenth Century New England* (New York, 1975).

[23] In a conventional two-sector, two-input model, when one sector grows more rapidly than the other, it necessitates bidding inputs away from the other sector. As a result, the return to the input in which the more rapidly growing sector is intensive, will rise relative to the return of the other factor. See Goldin and Sokoloff, "The Relative Productivity Hypothesis," for a more formal treatment.

[24] Wage rate data for women and children prior to industrialization of the Northeast are scarce, and even when such data are found, they have often already been affected by the quick upward response of female and child wages that occurred when opportunities for work in manufacturing establishments became available. In his article on the Brandywine area of Delaware, which industrialized very early, Adams reports nearly identical estimates of $(w_f/w_m)$ for agriculture (domestic work) and manufacturing. See Donald Adams Jr., "Workers on the Brandywine: The Response to Early Industrialization," *Working Papers from the Regional Economic History Research Center* (1980), Vol. 3, No. 4. Ware, *The Early New England Cotton Manufacture*, p. 241, reviews the evidence on the increase in the wages of domestics during this period.

the average rates for each particular class of workers (that is, females, boys) employed in the establishment.[25]

In Table 5, we present estimates of the ratio of the female wage to that of adult males for pre-industrial New England (1815) and for New England and the Middle Atlantic during early industrialization (1820 to 1850).[26] They reveal that the wage rates of females were bid up substantially relative to those of adult males as industrial development in the Northeast progressed, so that by 1850, the wage ratio prevailing there was well above its pre-industrial level.[27] We estimate that the wage ratio in manufacturing rose in New England from 0.37 in 1820 to 0.46 by 1850, but the magnitude of the implied shift in relative wages associated with industrialization is nearly doubled if one adopts the agricultural (or traditional sector) wage ratio for 1815 of 0.29 as the base. In the Middle Atlantic, the increase within the manufacturing sector was even more substantial, advancing from 0.30 in 1820 to 0.51 by 1850.[28]

[25] Firms in the *McLane Report* generally listed wage rates separately for men, females, and boys. We have checked the information provided by some firms with alternative sources of data, and have concluded that the reported wage rates were averages, across skill classes, of the wage rates of all workers in the particular category (i.e., females). For example, we checked the wage rates reported by the Hamilton Manufacturing Company in Lowell, Massachusetts, with the more extensive breakdown of female and male wages in that firm provided in Dublin, *Women at Work,* p. 66. A number of firms explicitly indicated that their labor force figures were annual averages. Since enumerators appear to have recognized the issues involved and preferred annual averages, we suspect that most firms sought to provide yearly averages. The firms included in the 1820 census also appear generally to have sought to estimate and report yearly averages.

There is no question that the wage rates from the 1850 census should be viewed as averages across skill classes for all workers in the particular category (males or females). Wage data were provided in the form of separate monthly wage bills for males and females. Firms in industries known to have employed many boys reported male wage rates (male wage bill/number of male employees) that were discernibly lower. It is unclear whether the labor force figures from 1850 are yearly averages or simply a count of workers during the most recent month. In any event, they do not involve the overcounting of workers with high annual turnover.

[26] Estimates of the wage of boys relative to that of adult males are not presented in Table 5, but are included in Goldin and Sokoloff, "The Relative Productivity Hypothesis," Tables 1 and 2. These ratios increase from about 0.15 in agricultural New England in 1815 to between 0.41 and 0.45 in industrial New England in 1832. We cannot compute a comparable figure for 1850 because children were not listed as a separate category. See footnote 6.

[27] As indicated above, we cannot compute a wage rate for boys in 1850. Nevertheless, the increase in the relative wage of boys between 1815 and 1832, as well as various impressionistic evidence, suggest that the relative boy wage continued for a time to rise with the relative female wage.

[28] Our 1850 wage ratio ($w_f/w_m$) differs from that cited in Lebergott, *Manpower in Economic Growth,* and used by Paul David in his work on technical change in cotton textiles, Paul David, *Technical Choice, Innovation and Economic Growth: Essays on American and British Experience in the Nineteenth Century* (London, 1975). The 1850 Census of Manufactures did not clearly state whether there was a lower age limit for the laborers included, and the 1880 Census of Manufactures, in a survey of trends, mistakenly claimed that the 1850 returns covered only adult laborers. In fact, the 1850 returns surveyed firms about all laborers, and thus the inclusion of boys in 1850 imparts a downward bias to the 1850 male wage when it is compared to the 1832 figure, for which boys are separated. Thus the Lebergott-David data indicate a marked increase in ($w_f/w_m$) from 1832 to 1850 and a sharp decrease in the male money wage over the same period. In constructing our 1850 figure we have used only industries in which boys were a small percentage of

This 1850 Middle Atlantic level approaches the ratio of 0.58 achieved by 1885 in the manufacturing sector. There have been only modest fluctuations around the latter level since that time.[29] Because the data in the 1832 and 1850 samples aggregated females of all ages but those beginning with 1870 did not, the high levels of the wage ratio estimated for the early years are even more impressive.[30]

Our finding of a major increase in this wage ratio is consistent with the observations of many contemporaries of the early nineteenth century who reported that the relative productivity (and wages) of women and children compared to adult men was low in the agricultural and traditional sectors of the pre-industrial northeastern economy. Women and children located in predominantly agricultural areas were widely perceived as a cheap source of labor for the expanding manufacturing sector. For example, Albert Gallatin, previously Secretary of the Treasury, noted in 1831 that

> female labor employed in manufactures appears from the rate of their wages to be more productive than if applied to the ordinary occupation of women.[31]

A year later, two northeastern manufacturers, surveyed in the *McLane Report* as to the employment opportunities for children outside manufacturing, responded that: "Children cannot be advantageously employed, and can get no wages" and "children, under sixteen, cannot obtain wages; their board and washing is generally considered of about as much value as their labor."[32] While these observations may suggest the existence of a disequilibrium in the labor market, most respondents to the *McLane Report* added that wages rapidly adjusted upward in both the agricultural and manufacturing sectors. "[T]he manufacturing interest has tended to depress that of the agriculturalist . . . on account of the

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the labor force, thus eliminating the problem of noncomparability of wages over time. This confusion over the meaning of the 1850 wage rates may explain why Nickless, "A New Look at Productivity in the New England Cotton Textile Industry," obtains different results from David by using skill classes rather than sex distinctions.

It should be noted as well that these wage ratios are lower than the ratio of the female wage to the adult male wage in the agricultural South. The southern ratio was approximately 0.58 in 1860. See Table 1, Goldin and Sokoloff, "The Relative Productivity Hypothesis."

[29] The evidence on the ratio ($w_f/w_m$) in manufacturing from 1885 to 1960 is from Claudia Goldin, *Economic Change and American Women* (in progress).

[30] Some firms in 1832 did report wage rates separately for adult females and girls. In such cases, we used only the adult female wage in the regressions. Our method of computing the wage ratios in 1832 and 1850 has introduced another downward bias. The calculations were based on the assumption that the average size of firms employing females was the same as that of firms employing adult males. Since wage rates were positively related to firm size, and females generally worked in larger establishments than men, the estimated male wage is biased upward relative to the female wage. Hence, the estimated wage ratio will be biased downward slightly.

[31] Albert Gallatin, "Free Trade Memorial," reprinted in F. W. Taussig (ed.), *State Papers and Speeches on the Tariff* (Cambridge, Massachusetts, 1892), p. 129.

[32] *McLane Report*, Vol. 2, p. 73 and p. 77.

TABLE 5
RELATIVE WAGES OF FEMALES TO MALES, PRIOR TO AND DURING EARLY INDUSTRIALIZATION

| | *Middle Atlantic* ($w_f/w_m$) | *New England* ($w_f/w_m$) |
|---|---|---|
| 1815 | | 0.288 |
| 1820 | 0.303<br>[0.255–0.328] | 0.371<br>[0.321–0.404] |
| 1832(a) | 0.411<br>[0.365–0.487] | 0.421<br>[0.373–0.499] |
| (b) | 0.432<br>[0.395–0.460] | 0.441<br>[0.404–0.470] |
| 1850(a) | 0.524<br>[0.428–0.630] | 0.437<br>[0.356–0.525] |
| (b) | 0.509<br>[0.463–0.554] | 0.460<br>[0.419–0.501] |

Notes and Sources:

1815: This ratio is computed from information contained in Massachusetts Bureau of Statistics of Labor, *Sixteenth Annual Report* (Boston, 1885), which gives 50¢/week for females (employed as domestics) and 86.8¢/day for males (employed in agriculture) without board. The female figure does not appear to include a value for board, and one of $1/week has been assumed. A 6-day work week was also assumed in order to calculate the weekly wage for males.

1820: Because the information on wages in the 1820 Census of Manufactures was reported as an annual wage bill for all employees, estimates of the female to male wage ratio were derived from a set of wage regressions run over the 1820 sample. Estimates of the wage rates for adult males, adult females, and children were retrieved from the firm data by estimating equation:

$$V/L = \beta_0 + \beta_1(L_f/L) + \beta_2(L_c/L) + \sum_i \alpha_i D_i + \varepsilon, \quad (1)$$

where V = the total wage bill, L = the total number of employees, $L_f$ = the number of adult female employees, $L_c$ = the number of child employees, $D_i$ = a set of industry and regional dummies and interaction terms, and $\varepsilon$ = the error term. The general form of equation (1) is derived from the identity:

$$V = \sum_j L_j w_j \qquad j = m,f,c \quad (2)$$

where $w_j$ = the annual wage rate for the jth class of labor, and the coefficients of equation (1) are estimates of:

$$\hat{\beta}_0 = \hat{w}_m; \quad \hat{\beta}_1 = (\widehat{w_f - w_m}); \quad \hat{\beta}_2 = (\widehat{w_c - w_m}) \quad (3)$$

The intercept of equation (1), the base wage of an adult male, must be combined with the contribution of the other appropriate independent variables to compute the estimated wage for the particular class of employees. The male and female wage rates were estimated separately, for several industries, before calculating a set of wage ratios from them. The calculated wage ratios varied somewhat over the industries in which males or females were employed. We have reported the average wage ratio, with the range appearing in brackets below. The average firm in the subset of firms over which the regressions were estimated was located in a county with roughly 60 percent of its labor force in agriculture.

1832(a): The 1832 estimates of the female to adult male wage ratios ($w_f/w_m$) are derived from wage regressions run over a sample of manufacturing firms drawn from the *McLane Report*. Adult male and female wages were estimated for a number of industries from the regressions appearing in Table 6, and a set of wage ratios was then computed from them. The wage estimates were

TABLE 5 NOTES AND SOURCES (continued)

calculated from the regression coefficients for a firm with the average number of workers (for that industry), that was located in a county where 40 percent of the population resided in urban areas. The average wage ratio is reported, with the range of estimates appearing below it in brackets.

1832(b): These ratios utilize the 1832(a) female wage estimates, but are divided by 1832 wage rates for common laborers in Lebergott, *Manpower in Economic Growth*, p. 541. The New England estimate of the 1832 wage for common laborers in the Middle Atlantic is, however, implausibly high. It implies that common laborers were paid higher wages than were the employees of most manufacturing industries, and that the nominal wage for common laborers fell in the Middle Atlantic between 1832 and 1850, while rising significantly in New England. Thus, instead of employing Lebergott's estimate of 96¢/day, we use a figure of 75.5¢/day, obtained by two independent methods. We have derived this estimate by applying the New England-Middle Atlantic wage differential from the regressions over manufacturing firms (in percentage terms) to the New England wage for common laborers. In addition, an average of the common laborer wage rates given by Donald Adams, "Wage Rates in the Early National Period: Philadelphia, 1785–1830," this JOURNAL, 28 (Sept. 1968), 404–26, and Jeffrey Zabler, "Further Evidence on American Wage Differentials," *Explorations in Economic History*, 10 (Fall 1972), 109–17, yields an almost identical estimate.

1850(a): The 1850 estimates of $(w_f/w_m)$ are derived from a set of wage regressions run over the sample of firms from the 1850 Census of Manufactures. They were computed in the same way the 1832(a) estimates were, with the same assumption about the level of urbanization. Because the 1850 census grouped men and boys together, we have only used male wage rates from industries which typically employed few boys.

1850(b): The $(w_f/w_m)$ estimates are based on the 1850(a) female wage estimates, but utilize Lebergott's estimates of the wages for common laborers in 1850 for the male wage.

expense of labor" was the conclusion of an agent in New Hampshire, and a correspondent in New York stated that "if those now engaged in the factories were thrown out of employ, wages [in domestic work] would probably be reduced . . . ."[33] Further support of our contention that industrial expansion in the Northeast increased the relative wage of women and children is provided by Henry Carey, whose analysis of wage rates written just after the *McLane Report* reported that:

> agricultural labor has not varied materially in these forty years [1793 to 1833] in its money price . . . the wages of men having been very steadily about nine dollars per month [with board] . . . [but] the wages of females have greatly advanced being nearly double what they were forty years since.[34]

The agreement between our estimates and the perceptions of early nineteenth century observers would seem to place the finding of an increase in the relative wage of females on a sound basis. Our explanation for the coincidence of this rise with the increase in the female share of the manufacturing labor force is that the diffusion of new methods of production during the early stages of industrialization boosted the relative productivity of women and children in manufacturing, leading

[33] *McLane Report*, Vol. 1, p. 742 and Vol. 2, p. 22.

[34] Henry C. Carey, *Essay on the Rate of Wages: With an Examination of the Causes of the Differences in the Condition of the Labouring Populations Throughout the World* (Philadelphia, 1835), p. 26.

to a substitution of such workers for adult males, and a surge in the demand for them. This theory can account for the proportion of manufacturing employees that were female (both within and across industries) growing at the same time that their relative wage was increasing. Although the expansion of the manufacturing sector is likely to have contributed to the advance of the relative wage, it does not by itself provide an adequate explanation of the observed phenomena. In the two-sector model referred to above, in which manufacturing is the sector relatively intensive in female labor, and output prices are determined exogeneously, an expansion of the manufacturing sector induced by neutral technical change or shifts in demand for output would generate an increase in the relative wage of females. If the increase in the relative wage was produced by such changes operating alone, however, it would have been accompanied by a decrease in the female share of the manufacturing labor force. Such a change in factor proportions in manufacturing did take place after about 1840 (as shown in Table 1), but not during the initial phase of industrial development.

Although some might rationalize the increase over time in the relative wages of females and children in ways other than we have suggested, our evidence does not support these alternative explanations. One such view is based on the assumption that when workers migrated to the manufacturing sector from the agricultural (or traditional) sector, they suffered a deterioration in working and other environmental conditions for which they had to be compensated. If females and boys required greater compensatory payments (in percentage terms) for laboring in industrial establishments than did adult men, then the sectoral shift from agriculture to manufacturing and the transition from the artisanal shop to the factory could account for the increase in their relative wages.

This conjecture can be investigated by utilizing the information contained in the samples of manufacturing firm data from 1832 and 1850. In theory, one should be able to determine the existence and magnitude of such compensatory payments by estimating the relationship between wage rates and environmental conditions. The chief problem with this approach is the difficulty of obtaining measures of the conditions for which workers demanded compensation. We have used the number of employees in the firm and the extent of urbanization in the local county as proxies for working conditions and environment, and regressed the wage for each class of employees on these variables and on dummy variables for industry and region.[35]

[35] The extent of urbanization in the local county was calculated as the fraction of the county population residing in cities with a population of 2500 or more. Since the poor environmental conditions thought to have affected many industrial workers were often linked to urban areas, our variable should be a reasonable proxy. The size of the manufacturing firm (as measured by the number of workers) might also be a useful proxy for undesirable working conditions for which employees would require compensation. Early factories may have had higher levels of noise and

TABLE 6
WAGE (ANNUAL) REGRESSIONS FOR ADULT MALES, FEMALES, AND BOYS: 1832

| | *Log (Adult Male Wage)* | *Log (Female Wage)* | *Log (Boy Wage)* |
|---|---|---|---|
| Intercept | 5.498 | 4.447 | 4.523 |
| | (108.49) | (53.52) | (32.39) |
| Log (% of County Population | 0.056 | 0.004 | 0.019 |
| Residing In Urban Area) | (4.98) | (0.18) | (0.67) |
| Log (Number of Employees) | 0.033 | 0.031 | 0.028 |
| | (4.27) | (1.98) | (1.38) |
| New England Dummy | 0.207 | 0.230 | 0.243 |
| | (9.44) | (5.18) | (4.26) |
| Industry Dummies: | | | |
| Cotton | 0.066 | 0.094 | −0.206 |
| | (1.42) | (1.48) | (−1.73) |
| Wool | −0.112 | 0.079 | −0.114 |
| | (−2.49) | (1.20) | (−0.97) |
| Iron | 0.012 | | 0.101 |
| | (0.24) | | (0.49) |
| Tanning | −0.144 | 0.182 | 0.080 |
| | (−3.00) | (1.09) | (0.55) |
| Shoes | −0.392 | −0.648 | −0.112 |
| | (−8.27) | (−9.25) | (−0.89) |
| Mills | −0.056 | | 0.435 |
| | (−0.76) | | (1.19) |
| Miscellaneous | 0.099 | 0.076 | 0.127 |
| | (2.31) | (1.10) | (1.08) |
| $R^2$ | 0.374 | 0.476 | 0.186 |
| Number of Firms | 853 | 414 | 284 |

Notes and Sources:

Annual wages were computed from the daily or weekly wages reported by assuming 310 days or 52 weeks of work per year. The equation for the adult male wage was estimated over all firms hiring at least one adult male; that for the female wage was run over firms employing at least one female; and that for the boy wage was run over firms hiring at least one boy. It varied somewhat over regressions, but the average firm was located in a county where roughly 30 percent of the population resided in urban areas. The intercept of each regression represents the annual wages of the particular class of employees in a Middle Atlantic paper mill. T-statistics appear in parentheses, below the corresponding regression coefficients. Several statistically insignificant industry dummies have been omitted.

Regressions estimated over the firm data from 1832 and 1850 are presented in Tables 6 and 7. In both years, the wage rates received by adult males increased with the size of the establishment and the degree of urbanization of the county in which it was located. Although these findings are consistent with the existence of the hypothesized compensatory differentials for males, there are alternative interpretations.[36]

dirt than did the small shops (or the farms) they replaced. These factories also appear to have been distinguished by a more regimented organization of work.

[36] For example, the urban-rural wage differential might be due to costs of migrating, or to higher average skill levels in urban areas. The positive relationship between male wages and firm size could be attributable to the disproportionate number of higher quality or more experienced workers in large firms.

TABLE 7
WAGE (MONTHLY) REGRESSIONS FOR MALES AND FEMALES: 1850

| | *Log (Male Wage)* | *Log (Female Wage)* |
|---|---|---|
| Intercept | 2.898 | 2.577 |
| | (29.78) | (23.75) |
| Log (% of County Population | 0.099 | −0.011 |
| Residing in Urban Area) | (6.56) | (−0.44) |
| Log (Number of Employees) | 0.024 | −0.011 |
| | (2.66) | (−0.48) |
| New England Dummy | 0.197 | 0.104 |
| | (11.45) | (0.26) |
| Industry Dummies: | | |
| Cotton | −0.104 | −0.161 |
| | (−0.44) | (−1.33) |
| Iron | 0.344 | −0.503 |
| | (3.11) | (−1.76) |
| Tanning | 0.178 | |
| | (1.76) | |
| Shoes | 0.107 | −0.526 |
| | (1.08) | (−5.93) |
| Household Goods | 0.239 | −0.220 |
| | (2.35) | (−1.28) |
| Perishables | 0.179 | −0.226 |
| | (1.70) | (−1.26) |
| Construction | 0.164 | −0.081 |
| | (1.67) | (−0.21) |
| Hand Trades | 0.212 | −0.275 |
| | (2.14) | (−0.95) |
| Miscellaneous | 0.180 | −0.133 |
| | (1.86) | (−1.54) |
| $R^2$ | 0.123 | 0.214 |
| Number of Firms | 1410 | 246 |

Notes and Sources:

The male wage regression was estimated over those firms employing at least one male and no females. By excluding those firms that employed females, we are also excluding many of the establishments that hired boys. Since adult males and boys were grouped together in the 1850 census, the wage rates for males reported by such firms do not accurately reflect those for adult males. The female wage regression was run over those firms employing both males and females. The intercept represents the wages paid by a woolen establishment (not significantly different in this regard from paper mills) located in the Middle Atlantic. T-statistics appear in parentheses below the corresponding regression coefficients. The average firm in the female wage equation was located in a county where 45 percent of the population lived in an urban area. In the male wage equation, the figure was 32 percent.

The elasticities of the female and boy wage rates with respect to firm size and urbanization, however, are estimated to have been less than or equal to those for males in each year, with their differences from zero often failing to be statistically significant. Thus these regression coefficients imply that an objective deterioration in environmental conditions (proxied here by size of firm and urbanization) for all classes of workers would have led to a decrease in the relative wages of women and children rather than an increase. It might be argued that the deterioration in conditions was worse for women and children, but the estimates of the increase in relative wages were based on the assumption that the

increase over time in firm size, within industries, was the same for males, females, and boys.[37] The argument also fails in the case of the urbanization proxy variable because of the absence of an urban-rural manufacturing wage differential for either females or boys. The rejection of the idea that the increase in the relative wages of females and boys was due solely to a pattern of compensatory payments receives additional support from the observations of Carey and others that relative wages rose in the traditional or agricultural sector as well. That relative wages increased in both the manufacturing and agricultural sectors indicates that the labor market was adjusting swiftly and efficiently to the increase in the demand for female and child workers.

The substantial representation of women and children in the manufacturing labor force and the rapid change in their relative wages that accompanied industrialization raise some intriguing questions concerning the basis for the Northeast's leadership in industrial development. Since these classes of workers were a quantitatively important input, the sharp variation observed in their relative wages may have had an effect on the location of manufacturing firms, and the types of production methods adopted. Manufacturers operating in a region where female and child labor was relatively cheap would have had a greater incentive to expand the scale of their enterprises and utilize the related female and child-intensive techniques than those located elsewhere. Population density might also have been a factor since the cost of attracting a substantial labor force would be higher in a sparsely populated hinterland.[38] Similarly, if one compares across industries at given factor price ratios, the industries that were most intensive in female and child labor would be most likely to locate in regions with low ratios of female and child wages to those of men.

This discussion of the implications of a significant regional differential in the relative wages of women and children is of more than hypothetical interest. As we have shown in a companion paper, females in the preindustrial South appear to have earned considerably higher relative wages than their counterparts in the Northeast during the first half of the nineteenth century.[39] We argue there that the regional discrepancy in

[37] As has been emphasized above, the average female worked (within an industry) in a larger establishment than did the average male. The assumption that there was no difference between the two groups tends to bias our estimates of $(w_f/w_m)$ downward slightly in each year. As for changes over time, it has the effect of exposing females and adult males to the same movement in the proxy for working conditions. Hence, compensatory payments due to increases in firm size over time could only account for the advance in the relative wages of females if a unit change in firm size had a greater effect (in percentage terms) on female wages than on male wages. As is clear from the regressions, this was not the case.

[38] The role of population density in the industrial development of New England is discussed in Ware, *The Early New England Cotton Manufacture*, p. 14.

[39] Goldin and Sokoloff, "The Relative Productivity Hypothesis." This paper asks how exogenous differences between the agricultural sectors of two economies affect the pace and pattern of industrial development, with examples drawn from the histories of the U. S. North and South.

relative wages (or relative productivity) was rooted in the different physical requirements associated with growing some of the principal southern crops (cotton, tobacco), as opposed to those associated with northern agricultural products. Our analysis suggests that such a regional discrepancy would lead to a disproportionate concentration of the female-intensive manufacturing sector in the Northeast, especially among the more female-intensive industries, and a greater tendency for northeastern firms, within industries, to adopt the larger-scale, female-intensive production methods.

The evidence on the divergence in industrial development between the Northeast and the South is quite consistent with these predictions. The former region devoted a much larger share of its resources to the manufacturing sector than did the South, and the Northeast's leadership in this regard was particularly pronounced in those industries most intensive in females.[40] For example, among the 25 most female-intensive manufacturing industries in 1850, there were 11.4 firms in the Northeast for each one in the South, while the ratio in all other manufacturing industries was only 4.5 to 1.[41] In addition, nearly all of the highly female-intensive industries in 1850 had much larger average firm sizes in the Northeast than in the South, indicating that firms, within industries, in the former region were more likely to expand their scale of production and increase the share of their employees that were women and children.[42] In contrast, the regional differences in establishment size were relatively small among the industries that were least female intensive. Other factors such as regional disparities in capital markets, human capital, population density, and transportation, also may have contributed to the comparative advantage of the Northeast in manufacturing. The regional difference in the relative wages of females and males seems, however, to have had an additional and empirically distinguishable effect of favoring a certain type of industrial development in the Northeast. This stimulus to the location of female-intensive industries in that region may have been particularly important during the initial stages of industrialization in the United States because many of the era's largest manufacturing industries, such as textiles and shoes, were highly female intensive.

[40] In 1850, nearly 60 percent of the white male (over age 15) labor force in the South was still principally employed in the agricultural sector. The proportion in the Northeast was below 35 percent.

[41] These figures were computed from information contained in U. S. Census Office, *Abstract of Statistics of Manufactures, According to the Returns of the Seventh Census*. The discrepancy is even greater if one makes the comparison between the most female-intensive industries and the least female-intensive industries or employs the number of workers (rather than firms) as the measure of development.

[42] For example, within the female-intensive boots/shoes, cotton textile, hats/caps, paper, and wool textile industries, northeastern firms had, on average, 2.6 times as many employees as southern firms did in 1850. Within the male-intensive flour mill, glass, iron furnace, nail, and tanning industries, northeastern firms had on average, only 1.2 times as many employees.

IV

As their absolute and relative wages rose during the early nineteenth century, an increasing percentage of women and children entered the labor force. The increasing labor force participation rates render the estimated advances in relative wages more impressive, since wage rates would have grown even more had the labor supply of women and children been inelastic, as was that of adult males. A precise estimation of these changes in labor force participation cannot at present be made. Nevertheless, since few women and children worked in northeastern agriculture or household industry during the pre-industrial period, their participation in the market economy must have risen substantially.[43] Contemporary observers linked increases in the labor force participation of women and children to the growth of the manufacturing sector. In his well-known "Report on Manufactures," Alexander Hamilton argued that the growth of manufacturing would result in "the employment of persons who would otherwise be idle" and that "in general, women and children are rendered more useful, and the latter more early useful, by manufacturing establishments than they would otherwise be."[44] Forty years later, manufacturers surveyed for the *McLane Report* appear to have shared the view that outside the manufacturing sector, "females . . . had little else to do" and "girls and boys have no other employment."[45]

Wherever significant industrial development occurred, labor force participation rates for young women seem to have been quite high. Although data are scarce, we are able to compile estimates of a "manufacturing labor force participation rate" for young females in 5 northeastern states and in the counties of Massachusetts. These estimates, which are presented in Tables 8 and 9, express the number of females counted in the various surveys and censuses as employed in manufacturing as a percentage of the total female population 10 (or 15) to 29 years old in the particular state or county. They are, accordingly, lower bounds to a true labor force participation rate of these young women if very few of the employed women were over 30 years old.[46]

[43] In most of the pre-industrial Northeast, women, and to a lesser extent children, seem to have worked only occasionally in the agricultural sector. See Percy W. Bidwell and John F. Falconer, *History of Agriculture in the Northern United States* (Washington, D. C., 1925), especially p. 116 and p. 275, and our discussion in Goldin and Sokoloff, "The Relative Productivity Hypothesis."

[44] Alexander Hamilton, "Report on Manufactures," reprinted in Taussig, *State Papers and Speeches*, p. 19.

[45] *McLane Report*, Vol. 2, p. 141.

[46] There is, however, evidence that during the early period, 88 percent of women working in the large textile mills at Lowell were under 30 years old. See Dublin, *Women at Work*, p. 258, footnote 9. Even in 1888, after manufacturing had become far more concentrated in urban areas, about 86 percent of all female industrial workers were under 30 years old. See Carroll Wright, *Working Women in Large Cities: Fourth Annual Report of the Commissioner of Labor, 1888* (Washington, D. C., 1889).

The estimates in Table 8 must be interpreted in light of the severe undercounting of firms in the *McLane Report* for all states but Massachusetts. Although figures for 1832 are uniformly lower than those for later years, a correction for this underenumeration would reduce these differences. Thus, the 1832 manufacturing participation rate estimates, ranging across states from 12 percent to 27 percent, indicate that the manufacturing sector was attracting a substantial portion of the population of young women in the Northeast. In the early-industrializing state of Massachusetts, where the reporting was most complete, one-third of all young females were employed in the manufacturing sector by 1850, if not before. This level roughly equalled that prevailing in 1880. In other states as well, increases in the manufacturing labor force participation

TABLE 8
FEMALES IN MANUFACTURING EMPLOYMENT AS A PERCENTAGE OF 10 (OR 15) TO 29 YEAR OLDS IN FIVE STATES: 1832 TO 1880

| | *1832* | *1837* | *1850* | *1860* | *1870*[c] | *1880*[c] |
|---|---|---|---|---|---|---|
| Connecticut | .116[a] | | .226 | .231 | .184 | .285 |
| | | | | | [.191] | [.337] |
| Massachusetts | .271[a,b] | .402[b] | .329 | .284 | .367 | .328 |
| | [.187] | [.297] | | | [.440] | [.395] |
| New Hampshire | .116[a,b] | | .201 | .220 | .217 | .281 |
| | [.105] | | | | [.266] | [.336] |
| New York | | | .080 | .068 | .092 | .153 |
| | | | | | [.108] | [.187] |
| Rhode Island | .266[a] | | .265 | .333 | .487 | .409 |
| | [.246] | | | | [.539] | [.450] |
| % of U.S. Total Female Manufacturing | | | .703 | .629 | .607 | .565 |
| Employment in Five States | | | | | [.613] | [.577] |

[a] The returns for Rhode Island listed women and children separately. The Massachusetts and New Hampshire estimates assume that 45 percent of all children were female and divide the total employment figure by those 10 to 29 years old. The bracketed figures give the employment of adult women as a percentage of those 15 to 29 years old. The Connecticut estimate is only for adult females and has been expressed as a percentage of females 15 to 29 years old. In all cases, the population figures for 1832 are for white females only and are from U.S. Department of State, *Fifth Census: Or, Enumeration of the Inhabitants of the United States* (Washington, D. C., 1832).

[b] The estimates include women in home workshop employment, mainly palm leaf hats and straw hats, bonnets, and braids; the bracketed figures exclude them. See Table 9, notes for Col. (1) and (2).

[c] Children were allocated between boys and girls as given by the 1880 population figures for children in manufacturing employment by states in the U.S. Census Office, *Report on the Manufactures of the United States*, Vol. 2, p. xxx. The bracketed figures express the number of females employed in manufacturing as a percentage of those 15 to 29 years in the population.

Sources: Same as for Table 1, and U.S. Department of State, *Fifth Census: Or, Enumeration of the Inhabitants of the United States;* U. S. Department of State, *Sixth Census or Enumeration of the Inhabitants of the United States;* U. S. Census Office, *The Seventh Census of the United States: 1850* (Washington, D. C., 1852); U. S. Census Office, *Eighth Census of the United States: 1860. Population of the United States in 1860* (Washington, D. C., 1864); U. S. Census Office, *Ninth Census of the United States: 1870. The Vital Statistics of the United States,* Vol. 2 (Washington, D. C., 1872); and U. S. Census Office, *Tenth Census of the United States: 1880. Statistics of the Population of the United States at the Tenth Census,* Vol. 1 (Washington, D. C., 1883).

rate of young females continued after 1850, but had by that date already reached levels approaching those achieved 20 or 30 years later.

Recognizing that some young women were employed in alternative pursuits such as domestic service and teaching, the crude manufacturing labor force participation rates indicate that a high proportion of single women in New England had been drawn into the market economy by the 1830s.[47] Comparable evidence on female labor force participation before 1832 is not available, but the levels implied by the 1830s data must have been achieved quite rapidly, since opportunities for the employment of females were limited prior to industrial development. This conjecture is supported by our estimates for the counties of Massachusetts in 1832 and 1837, presented in Table 9. In the more industrialized eastern counties (Essex, Middlesex, Bristol, Suffolk, and Norfolk), an extremely high percentage of young single women, at least equal to the statewide figure at the end of the century, must have been employed in the manufacturing sector. The western counties more closely resembled a pre-industrial region, and females in those areas had far lower manufacturing labor force participation rates.

There remains a question as to whether the contrast between the two sets of counties reflects a difference in the behavior of females native to the respective counties or the migratory patterns of young females to and within Massachusetts. The high participation rates observed in the eastern counties could have resulted from a disproportionate number of migrant female workers choosing to locate there and thus be ambiguous labor market indicators. The greater the migratory flows and the stronger the tendency to locate in eastern Massachusetts, the more powerful this factor would be in accounting for the high measured manufacturing labor force participation rates in that more developed region.

In the last four columns of Table 9, we present estimates of net migration rates, computed by the forward survivor method, of young women into Massachusetts counties during the 1820–1830 and the 1830–1840 periods. These migration rates are expressed in terms of the percentage of the particular age group in the end year, where three age groups are included for the 1830–1840 period, and only one (10-19 years) for the earlier period. The broad age categories utilized in the 1820 census prevent the calculation of rates for the other groups. Our estimates imply that the high rates of manufacturing labor force participation in the eastern countries do reflect the behavior of the natives, because they had been achieved by 1832 when in-migration was

[47] The manufacturing participation rates are computed from firm reports of the average number of female workers employed over the year. They are, accordingly, implicitly adjusted for the job turnover that Dublin has found among female workers in Lowell. See his *Women at Work*, pp. 59–60. To the extent that young women frequently went in and out of the labor force, our estimates will understate the percentage of them engaged in the market economy for some portion of the year.

TABLE 9
MANUFACTURING EMPLOYMENT OF FEMALES AND MIGRATION WITHIN AND TO MASSACHUSETTS: 1832 AND 1837, AND 1820 TO 1840

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | *Female Manufacturing Workers as a Percentage of Females 10–29 Years Old* | | | | *Net Migration of Females 10–19 Years* | | *Net Migration of Females* 20–29 Years | 30–39 Years |
| | | | | | *(Expressed as a % of those 10–19 in later year)* | | *(Expressed as a % of those 20–29 or 30–39 in later year)* | |
| *County* | *Firms 1832* | *Firms 1837* | *Firm and Workshop[a] 1832* | *Firm and Workshop[a] 1837* | *1820–30* | *1830–40* | *1830–40* | *1830–40* |
| Essex | 28.6 | 44.7 | 28.6 | 44.7 | 2.2 | 6.7 | 5.5 | 10.9 |
| Middlesex | 25.4 | 43.1 | 26.5 | 47.0 | 14.9 | 29.8 | 41.8 | 1.6 |
| Bristol | 22.3 | 25.9 | 34.0 | 34.3 | 10.6 | 9.7 | 11.4 | −1.1 |
| Worcester | 21.1 | 28.7 | 42.1 | 49.7 | 2.0 | 2.6 | 8.3 | −7.9 |
| Norfolk | 21.0 | 30.6 | 66.0 | 73.7 | 6.4 | 15.7 | 22.9 | 2.6 |
| Suffolk | 20.0 | 21.6 | 20.0 | 29.0 | 21.3 | 23.7 | 49.5 | −1.2 |
| Hampden | 17.0 | 28.1 | 17.9 | 29.7 | 5.5 | 15.7 | 9.1 | −8.4 |
| Berkshire | 12.0 | 16.6 | 12.0 | 16.6 | −10.3 | −2.0 | −2.0 | −15.6 |
| Hampshire | 11.7 | 11.0 | 28.6 | 33.4 | 1.2 | −3.3 | −13.4 | −17.0 |
| Plymouth | 8.8 | 21.3 | 11.2 | 26.0 | 3.6 | 4.8 | −11.3 | −2.8 |
| Franklin | 4.1 | 4.9 | 11.6 | 15.1 | −16.3 | −13.3 | −25.4 | −14.7 |
| Barnstable | 2.4 | 1.7 | 2.4 | 1.7 | 0.5 | −3.4 | −6.6 | −5.1 |
| Dukes[b] | 0 | 0 | 0 | 0 | −1.2 | 2.9 | 12.5 | −4.2 |
| Nantucket[b] | 0 | 0 | 0 | 0 | −4.8 | 12.3 | 7.2 | −2.6 |
| Entire State | 18.7 | 29.7 | 27.1 | 40.2 | 4.8 | 11.2 | 19.6 | −3.5 |

[a] Workshop employment consisted almost entirely of the production of straw products and palm leaf hats by families in their homes.

[b] Because there were manufacturing firms in these counties in 1820, it is possible that there was an undercounting of such firms in 1832 and 1837.

Notes and Sources:

Col. (1) The county-level manufacturing employment estimates were drawn from the *McLane Report*. The figures for the population of females, 10 to 29 years old, came from U. S. Department of State, *Fifth Census: Or, Enumeration of the Inhabitants of the United States.*

Col. (2) The county-level manufacturing employment estimates were drawn for 1837 from Bigelow, *Industry in Massachusetts,* pp. 169–200. Data for Suffolk County were added separately from the stated returns, because the summary tables divide employment by sex only for major industries. Female employment in the printed cotton goods industry was derived by multiplying total employment by 0.75, the percentage of employees who were female in cotton textiles. The figures for the population of females, 10 to 29 years old, were derived for 1837 from U. S. Department of State, *Fifth Census: Or, Enumeration of the Inhabitants of the United States* and U. S. Department of State, *Sixth Census or Enumeration of the Inhabitants of the United States,* by assuming a constant rate of increase between 1830 and 1840.

Col. (3) and Col. (4) Workshop employment is defined as the number of "full-time" persons producing goods in the home for market sale. "Full-time" equivalents were derived for both 1832 and 1837 based on information in the *McLane Report*. Detailed information on palm leaf hat production in Worcester indicated that woman working full-time produced 1.58 hats per day; each hat sold for 28¢ and each woman received 30¢ per day on average. Laborers, therefore, received two-thirds of gross earnings. If the dollar value of straw products and palm leaf hats equals V; the number of full time laborers, L, is given by: L = [V(2/3)/90], where $90 was the full-time yearly earnings of a woman working 300 days per year. The figures derived are comparable to, but somewhat less than, the full time female labor equivalents given by the enumerators in the *McLane Report* for several counties.

Col. (5) and Col. (6) These figures are the number of females who migrate to (or from) a county, on net, as a percentage of the number at the later year. Because of the wide age groupings given in U. S. Department of State, *Census for 1820,* this calculation could only be done for females of ages 0 to 9 in the early year, surviving to ages 10 to 19 in the later year. The 1830 population figures came from the source cited in the note to Col. (2). The procedure used was the forward survivorship method. The estimate of the percentage (0 to 9) years surviving to (10 to 19) years used is 0.93. This estimate is somewhat high considering that Massachusetts in 1828–30 had a life-table for women resembling a "West" Model level 11 or 13. See Maris Vinovskis, "Mortality Rates and Trends in Massachusetts before 1860," this JOURNAL, 32 (June 1972), 184–213. It is most probable that the number of very young children was consistently underestimated and, therefore, high survivor rates were used. If $\rho$ = survivor rate, the table gives:

$$\left[\frac{(P_{10\text{–}19}^{1830}) - \rho(P_{0\text{–}9}^{1820})}{P_{10\text{–}19}^{1830}}\right]$$

where $P_n^t$ is the population of age group n in the year t.

Col. (7) and Col. (8) The same procedure is used as in Col. (5) and (6); $\rho = 0.90$ for (7) and .85 for (8). The population figures are from the sources cited in the note to Col. (2).

relatively low. Judging from the migration rates of the 10-19 year age group, inter-county migratory flows increased between 1820–1830 and 1830–1840. Whereas early industrial establishments in Massachusetts may have at first drawn their female employees from local areas, they were increasingly able, over time, to attract long-distance migrants from other counties in the state, as well as from other parts of New England, Canada, and Europe. This heightened movement of female labor may explain why the coefficient on firm size in the 1850 wage regression (Table 7) differs from that for 1832 (Table 6); firms may have initially been faced with a fairly steep labor supply function which migration tended to lower.

Despite the continuing increase in the rate of participation by women in the manufacturing sector, the proportion of its labor force that they comprised seems to have peaked prior to 1850. The movement of females into this work force was eventually outweighed by the shift of adult males from agriculture to manufacturing. Within the Northeast, we estimate that the share (see Table 1) fell from roughly 33 percent in 1832 to 29 percent in 1850 (24 percent without clothiers), and to even lower levels later in the century. In Massachusetts the decline was more abrupt, from 49 percent in 1837 (including home workshop production) to 39 percent in 1850 (36 percent without clothiers and tailors). Among the possible contributors to this secular decline are the growth of the female-intensive manufacturing sector and other factors that drove up the relative wage of females, the slowdown in the growth of the highly female-intensive industries (that is, textiles) relative to the manufacturing sector as a whole, and the direction of technological change after the 1830s, which may have begun to be male-augmenting in character.[48] The data do not permit us to compute robust estimates of the relative importance of these contributors for the Northeast as a whole. A decomposition of the Massachusetts decline in the female share of the manufacturing labor force between 1832 and 1850 suggests, however, that roughly two-thirds of it was due to changes in industrial composition, and the remainder to changes in the industry-level female shares.[49]

[48] The decline in the female proportion of the manufacturing labor force has played a prominent role in the history of the cotton textile industry. See Dublin, *Women at Work*, and Ware, *The Early New England Cotton Manufacture*, both of whom stress immigration and technical change as causal factors.

[49] The data underlying the calculaton are from the 1832 sample and U. S. Census Office, *Abstract of Statistics of Manufactures, According to the Returns of the Seventh Census*. Using a slightly different formulation from that discussed in footnote 11, the female share

$$P_f = \sum_i X_i I_i$$

and the sources of change have been averaged over the two ways of factoring $P_f^{1850} - P_f^{1832}$.

## V

We have explored the role of women and children in the industrialization of the American Northeast, an issue originally raised by Hamilton, Gallatin, and other observers of the Early Republic. Our principal findings tend to confirm their judgment that these groups were an important resource to industrial establishments of that era, and include: (1) that women and children composed a major share of the entire manufacturing labor force during the initial period of industrialization, but that this share began a secular decline as early as 1840; (2) that the employment of these groups was closely associated with production processes used by large establishments across a broad range of industries; (3) that the wage of females (and boys) increased relative to that of men wherever industrial development spread; and (4) that the labor force participation of young, unmarried women in the industrial counties of the Northeast achieved levels that were high by late nineteenth-century standards.

Some of the most interesting implications of these findings concern the extent and nature of technical change during the early stages of industrialization. Since variation across firms in the types of workers employed should reflect differences in the production processes utilized, the disproportionate employment of women and children by medium- and large-sized firms suggests that the production methods of even non-mechanized factories differed significantly from those of the traditional artisanal shops. Given that average firm size was increasing in most industries over the first half of the nineteenth century, technical change appears to have been prevalent throughout the manufacturing sector rather than confined to a few highly mechanized industries.

The factors accounting for the disproportionate employment of women and children, presumably by raising the productivity of these classes of workers, may have been the most important feature of the early factory. We have argued that measures intended to achieve an intensification and division of labor were frequently implemented in the factories of the period, and could have played such a role. At the very least, they constituted an alternative stream of technological change that complemented the more widely recognized means of conserving on adult male labor, substituting capital for labor.

The findings are also relevant to another question about the record of industrialization in the United States: Why was industrial development concentrated in the Northeast? As has already been noted, the findings suggest that the Northeast enjoyed a comparative advantage, relative to the South, in manufacturing industries that were intensive in female and child labor because those classes of workers were relatively cheaper there. This analysis, however, also contains the basis for an explanation

of why the Northeast might have developed a comparative advantage for manufacturing in general. As the highly female- and child-intensive industries that were among the largest of the early nineteenth century tended to locate in the Northeast, they may have fostered the evolution of conditions such as the improvement of capital markets, the expansion of transportation and merchandising networks, and the higher levels of human capital that were favorable to all manufacturing. Thus, the Northeast's initial comparative advantage in those industries could have contributed to the emergence of a long-term advantage for manufacturing in that region.